CLARIFIED MAPLE SAP - A NEW PRODUCT

ARS-NE-45
October 1974

AGRICULTURAL RESEARCH SERVICE • U.S. DEPARTMENT OF A

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INTRODUCTION

Maple sap, regarded as a raw material rather than an item of commerce, is marketable only where it can be sold to a central evaporator plant. This market for sap is economically limited, mainly by the cost of delivery to areas within a 25-mile radius of a central plant and by the fact that as many as 40 gallons of sap must be processed to produce 1 gallon of sirup. In 1974, sale to a central evaporator is probably the only means by which income is gained from the harvest of sap without processing it to sirup.

Producers of maple sirup have long sought ways to make a marketable item from sap other than maple sirup or sugar products. Attempts to produce bottled sap products, however, have failed for technological reasons rather than lack of interest on the part of the buying public.[2/]

Maple sap has a certain consumer appeal as evidenced by its use as a novelty drink during the sap flow season. Current interest in natural foods presents a possibility for sales beyond the novelty market. In addition, the sap could be used as a mixer for alcoholic beverages in much the same manner as mountain spring water (branch water). In fact, every maple sap producing region has its own formula for brewing sap beer, a product that probably originated with colonial brewers. Thus, there are many possible commercial outlets for maple sap, but the sap must be processed and packed in such a way that it will maintain its wholesomeness and attractiveness to the consumer.

The extremely perishable nature of maple sap has always been a problem for maple producers. The old belief that "the best sirup is made from sap gathered and processed within 24 hours after it flows from the tree" was based on bitter experience. Even in modern times, maple producers have had to install germicidal ultraviolet lights over sap storage tanks to control microbial activity that lowers sirup quality or even destroys stored sap. Coldpacking of sap, even under the most sanitary conditions, inevitably resulted in a haze caused by microbial growth in the product within 2 to 3 days after packing. In extreme cases, a visible mass of microbial slime appeared in the sap.

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2/ Nessly, R. S. Maple product for beverage, flavoring and the like. (U.S. Patent No. 3,397,062.) U.S. Patent Office, Off. Gaz. 853: 522. 1968.

Recently developed methods for sterile coldpacking liquids are impractical for maple producers, because equipment costs are so high that they cannot be justified on the basis of seasonal undertaking. The hotpacking method used in canning sirup or that used in home canning of fruits and vegetables has been attempted in bottling maple sap. In the hotpacking method the containers were filled with sap and heated to 180° to 190° F. After capping, the container was inverted or laid horizontally to heat-sterilize the container neck and cap liner. In the home-canning method the sap was packed in the container that was subjected to steam heat sterilization. These methods succeeded in solving the problem of microbial spoilage, but the heating process denatured heat precipitable materials which occur naturally in maple sap. As the sap cooled, these materials settled to the bottom of the container. Hence, the product was not fit for sale because of its poor appearance.

This publication describes a new process whereby a crystal-clear sap product can be made that can be bottled and sold "as is" or given further processing such as carbonation and color additives, to make new products. This clarified maple sap also can be concentrated to any desired Brix up to sirup density for use in making new products.

MATERIALS

Raw maple sap.-- A maple sap of good sanitary quality, 2.0° Brix or higher in solids, free from off flavors (buddy, musty, residual cleaner) or color (yellow from rusty gathering equipment) must be used if a good sap product is to be made. Sap was collected in plastic bags or with a plastic tubing system from trees with paraformaldehyde pelletized tapholes.

Stock pot.-- A sanitary vessel equipped with an agitator and having a controlled heat source (electrical, gas, or steam) to raise the sap temperature rapidly to 165° F. The size of the vessel is determined by the scale of operation.

pH meter.-- Any of the commercially available pH meters.

Filter.-- The filters used for the removal of sugar sand from maple sirup.

Lime, N.F.-- Lime, N.F. (calcium oxide used in the food and pharamaceutical industries) can be obtained in powder form from chemical supply companies, such as the Fisher Scientific Co. Gulph Road, King of Prussia, Pa. 19406[3/] or J. T. Baker Chemical Co., Phillipsburg, N. J. 08865.

Malic acid.-- Food grade malic acid obtainable from companies supplying acidulants to the food industry, such as the Allied Chemical Corp., Specialty Chemicals Division, Morristown, N. J. 07960.

3/ Mention of a company or trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned. This is given solely for the purpose of providing specific information.

METHOD

Precipitation Procedure

1. Add lime powder to the sap slowly, until the desired pH (9.5) of the sap is reached. Stir the sap continually while adding the lime. Caution: Our experiments have shown that approximately 2.5 g (less than 1/10 oz) of lime are required to adjust 1 gal. of normal sap to pH 9.5.

2. Heat the limed sap to 165° F and cool to or below 100° F. The heat precipitable materials will precipitate during the heating and cooling process. Heating to 165° serves to flash pasteurize the sap, killing most of the viable sap micro-organisms. The process can be interrupted at this point and the sap can be held until the following day, if desired.

3. Filter the sap to remove the precipitate. The filtrate should be crystal clear and have a pH of 7.7 to 8.0.

4. Add malic acid to the filtrate until its pH ranges from 6.8 to 7.0. (If a carbonated soft drink is to be made, adjust the pH range from 3.5 to 4.0 at this time.)

5. Bottle the processed sap and sterilize the bottled product in a pressure cooker by using 15 pounds of steam pressure for 15 minutes or follow the same procedure used in hotpacking sirup -- fill container with hot (180° to 190° F) sap and invert the bottle immediately after capping. The steam sterilization procedure is more effective in minimizing losses caused by spoilage.

Sap Studies

The optimum pH for this process was determined by adding lime to aliquots of sap taken from a midseason sap run. The pH values of the respective aliquots were adjusted as follows: (1) Untreated control (pH 6.8); (2) pH 7.5; (3) pH 8.5; and (4) pH 9.5. The aliquots were then heated to 165° F, cooled to 100° and filtered through Whatman No. 4 filter paper. Malic acid was added to the respective filtrates to adjust the pH to 6.8, and the products were placed in 8 oz screw-cap bottles and sterilized in an autoclave (15 minutes at 15 pounds p.s.i.). After the bottles cooled to room temperature, the filtrates were inspected for clarity and precipitate formation.

The effects of intraseasonal variation and different processing temperatures on precipitate volume in processed sap were studied during the 1972 sap season. Sap for this work was gathered from early season, midseason, and late season, sap flows. Lime was added to three, 1-liter aliquots from each sap flow to adjust the sap to pH 9.5. The aliquots were then heated to 120°, 140°, and 165° F, respectively. The volume of precipitate formed in each aliquot was measured by placing the heated sap in an Imhoff cone and allowing the precipitate (ppt.) to settle overnight. Results were expressed in ml. of settled ppt./liter of sap. Each aliquot was processed to a finished product as previously described.

RESULTS AND DISCUSSION

In the studies to determine the pH level required for complete precipitation of heat precipitable materials from the maple sap, a wide variation was noted in the settling qualities of the precipitates formed in the sap aliquots. That from the untreated control was bukly and slow in settling. As the lime additions were increased, the precipitates formed became more compact and settled more rapidly. For this reason, no attempt was made to measure the relative amounts of precipitate by settling in an Imhoff cone. The major goal was to establish a pH level that would remove heat precipitable materials so effectively from the sap that the final product would be crystal clear. The product made from untreated sap developed a heavy ppt., which was typical of the sap products attempted elsewhere. The pH 7.5 product had a slight ppt. and the pH 8.5 product had a haze in it. The pH 9.5 product was clear with neither ppt. nor haze developing in it during 6 months' storage in a refrigerator. Therefore, pH 9.5 was selected as the pH level at which this material could be removed from sap to yield a clear-sap product (fig. 1).

Data from the study of intraseason variation and the effect of temperature on precipitate volume in processed sap are shown in table 1. It is doubtful that a producer would use first run sap for this purpose. Early season sap usually makes the best sirup, probably because of the freshly cleaned equipment in use at that time and the low level of invert sugars in the sap. Moreover, the small amount of very fine precipitate found in the early season sap could be difficult to filter with the relatively coarse filters in use in the industry.

As the season progressed, the volume of ppt. increased sharply. This reflected the changes in sap as the maple progressed to the budding stage. Products made from aliquots heated to 120° and 140° F were unsatisfactory, showing haze in the product within 24 hours after packing. The aliquots heated to 165° yielded a clear product in all cases. The 165° F heat treatment yielded the greatest volume of precipitate as measured in the Imhoff cones from each sap aliquot tested. These data show that a clear-sap product can be made from raw maple sap of good sanitary quality by the new process.

Table 1.--Volume of precipitate in Imhoff cones from early, midseason, and late-season sap aliquots limed to pH 9.5 and heated to 120°, 140°, and 165°F

1972	Ppt. vol. (ml/1) in sap heated to --		
	120° F	140° F	165° F
Early season	1/	2.5	3.0
Midseason	5.0	5.0	8.0
Late season	5.0	15.0	18.0

1/ Trace.

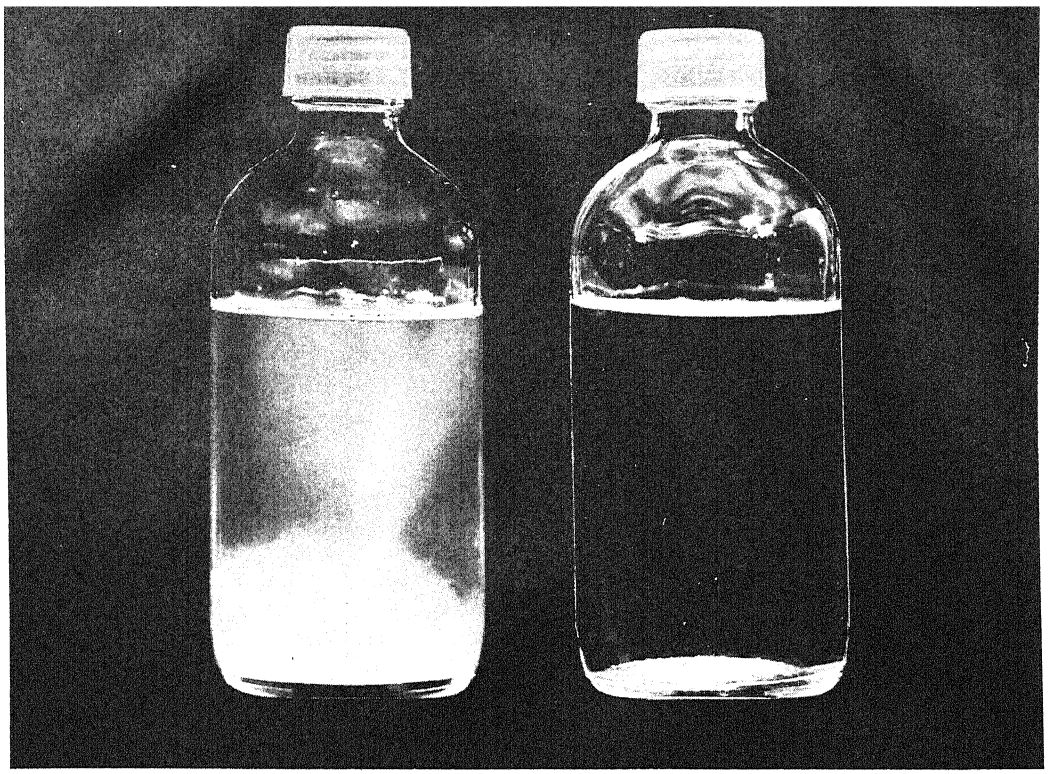

Figure 1.--Haze and settled material in raw maple sap (left). Clarified maple sap (right).

This product has a bland, slightly sweet taste. Samples have been stored for as long as 6 months under refrigeration at the Eastern Regional Research Center without deterioration in flavor or appearance. As a base for soft drinks, mixer for alcoholic beverages, or with further acidification and carbonation as a soft drink, this clarified maple sap offers a good profit potential to maple producers. One lot of sap product was acidified to pH 4.0 with malic acid and carbonated in a soda water syphon. The carbonated product had the expected acid tang from the addition of malic acid and a slight vanilla flavor resembling that of a dilute cream soda.

CONCLUSION

A clarified maple sap product, free of haze or precipitate, can be made from maple sap by:

1. Adding lime N.F. to adjust the sap to pH 9.5.
2. Heating to 165° F and cooling to or below 100° F.
3. Removing precipitate by filtration.
4. Adding food grade malic acid until the filtrate ranges from pH 6.8 to 7.0.
5. Bottling the processed sap and sterilizing the bottled product.